and lower limb joint disease. In china some traditional Chinese medicine (TCM) doctors frequently advocated it as a useful physical exercise as a substitutivetreatment of lower limb problem such as knee osteoarthritis (OA). However whether such a kind of exercise can help to reduce the loading at the knee joint during walking has not been fully investigated and little comprehensive study on the kinematics and kinetics in backward walking has been done. The purpose of this study was to look into the biomechanics involved in backward walking and find out whether BW would result in a reduction in the knee loading during gait. The study was designed to identify the biomechanical function of backward walking and answer the questions such as whether backward walking can be a new type of gait modification training program for medial compartment OA knee subjects in future.
Methods: Twenty 20 subjects (15 male 5 female, age 25.55±3.70 years, height 1.73±0.08 m, body mass 71.27±11.58kg) were recruited from the postgraduate students of University of Shanghai Traditional Chinese medicine. The volunteered subjects were explained in detail about the protocol of the study and they gave their written consent before joining the tests. A 10-camera (T40s) VICON motion capture system (Nexus 1.8.4, Oxford, UK) and 4 AMTI force platforms (OR6-6, AMTI, Watertown, US), were used to record the kinematics and kinetics data during both forward and backward walking.
Results: Results are showed in Table 1. BW showed smaller stride length. Compared with the forward walking (FW), BW showed significantly smaller value in knee flexion, both 1st and 2nd peak of the external knee adduction moment (EKAM), and the knee adduction angular impulse (KAAI) [Fig 1]. However, the percentage of the stance phase in a gait cycle was found will little difference between the two conditions. (Table 1)
Conclusions: The results from the study confirmed the different biomechanical features of backward walking, which could contribute the reduction of the knee loading during gait. The effect of the backward walking exercise over a longer term need further study to determine whether the response in the knee loading would remain, a further long term follow up research has been planned in the authors' gait lab.

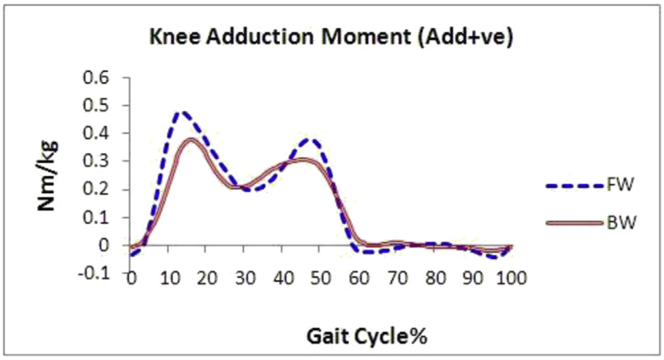

Fig. 1. FW=forward walking. BW=backward walking.

Table 1.

Variable	FW (Mean±SD)	BW (Mean±SD)	P-value
1st Knee adduction moment (Nm/kg)	0.49±0.13	0.40±0.15	0.000**
2nd Knee adduction moment (Nm/kg)	0.39±0.13	0.32±0.12	0.000**
Knee adduction angular impulse ((Nm/kg)•s)	0.16±0.05	0.15±0.07	0.009*
Stance phase percentage in a gait cycle (%)	60.61±1.02	61.31±1.93	0.190
Stride length (m)	1.39±0.08	1.28±0.11	0.000**

168
ACUTE INFLUENCES OF DRAW-IN MANEUVER FOR SPINE ALIGNMENT AND KNEE ADDUCTION MOMENT DURING GAIT

S. Ota †, R. Kano †, S. Fukuta †, R. Miyai †, H. Ohko †, K. Hase ‡. † Seijoh Univ., Tokai, Japan; ‡ Tokyo Metropolitan Univ., Hachioji, Japan

Purpose: The aim of the study is to investigate the influences of the continuous draw-in maneuver (DI) for spine alignment (thoracic kyphosis and lumbar lordosis) during standing and knee adduction moment (KAM) during gait in healthy young individuals.
Methods: Twenty-nine healthy adults, 15 men and 14 women (21.6 ± 1.1 years old), participated. The same verbal order for DI was used "Please hollow your belly slightly." Our pilot study shows that the posture with DI serves to decrease abdominal circumference by 2.1 cm and increase the abdominal external oblique muscle by 70% compared to normal standing. Thoracic kyphosis and lumbar lordosis angles were measured using Spinal mouse (Idiag AG) in normal standing and standing with DI. The participants were required to maintain DI during gait, and the DI confirmed the same 2.1cm abdominal circumference decrease using a non-elastic cord. A 3-D motion analysis system (Venus 3D; Nobby Tech) with a 10-camera and a force plate (Accugait; AMTI) was used to obtain external KAM normalized body weight. The first and second peaks of KAM were used for the final analysis. Also, the lengths of lever arm on the frontal knee joint plane were measured. The study was approved by the Ethics Committee, the nature of the study was explained to all participants, and written informed consent was obtained.
Results: Thoracic kyphosis angles in DI (41.0 ± 7.4 degrees) were significantly decreased compared to the angles in normal standing (43.0 ± 7.9 degrees, $p<0.05$). Figure 1 shows the changes with DI in all participants. Twenty subjects showed decreased thoracic kyphosis angle from normal standing to standing with DI, and in nine subjects it was increased. Lumbar lordosis angles in DI (24.9 ± 10.1 degrees) were not significantly different compared to the angles in normal standing (24.3 ± 9.5 degrees). The 1st and 2nd peak KAMs were not significantly different in either condition (Table 1). In twenty subjects with decrease of the thoracic kyphosis angles, the 1st peak KAM in DI conditions was significantly decreased (control gait: 0.47 ± 0.17 Nm/kg, gait with DI: 0.43 ± 0.17 Nm/kg, $p<0.01$). The 2nd peak KAM was not significantly different (Table 1). The lever arm of 1st peak KAM in DI was significantly shorter than the length in normal standing ($p<0.05$).
Conclusions: Although DI served to significantly decrease thoracic kyphosis, 30% (9/29) of the subjects did not show a decreased kyphosis angle. Only the participants (20/29) with decrease of thoracic kyphosis angles evidenced a decrease of 1st peak KAM due to the shorter lever arm. Gait with DI which serves to decrease thoracic kyphosis is thought to be one of the gait modifications for the prevention of medial knee osteoarthritis.

Table 1. Difference of knee adduction moment between control gait and gait with Draw-in

		Control gait	Gait with Draw-in	
All participants (n=29)	1st peak KAM	0.48 ± 0.19	0.46 ±0.22	n.s.
	2nd peak KAM	0.45 ± 0.14	0.45 ± 0.17	n.s.
Decreased thoracic kyphosis group in Draw-in (n=20)	1st peak KAM	0.47 ± 0.17	0.43 ± 0.17	p<0.01
	2nd peak KAM	0.44 ± 0.13	0.42 ± 0.13	n.s.

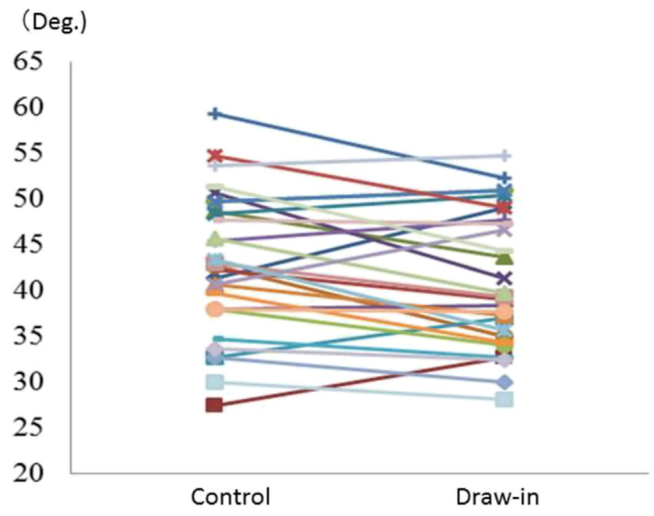

Figure 1. Changes of thoracic kyphosis angles between control and Draw-in.